PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
G06F 159:00

A1

(11) International Publication Number: **WO 98/16895**

(43) International Publication Date: 23 April 1998 (23.04.98)

(21) International Application Number: PCT/US97/18175

(22) International Filing Date: 7 October 1997 (07.10.97)

(30) Priority Data:
08/732,158 16 October 1996 (16.10.96) US

(71) Applicant: RAYA SYSTEMS, INC. [US/US]; Suite 520, 2570 W. El Camino Real, Mountain View, CA 94040 (US).

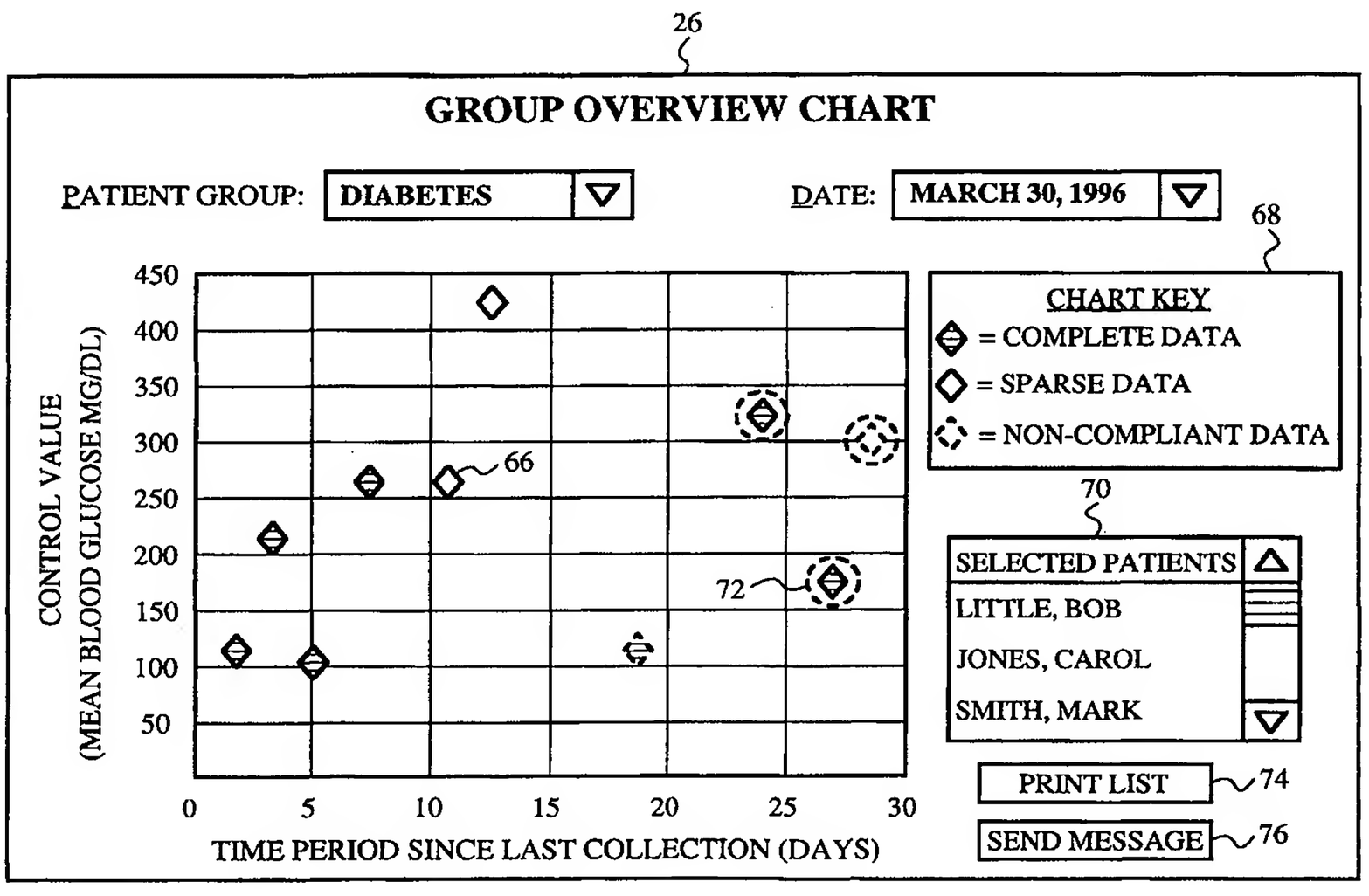
(72) Inventor: BROWN, Stephen, J.; 875 Linda Vista Avenue, Mountain View, CA 94043 (US).

(74) Agent: ALBOSZTA, Marek; 426 Lowell Avenue, Palo Alto, CA 94301 (US).

(81) Designated States: AU, CA, CN, JP, MX, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: MULTIPLE PATIENT MONITORING SYSTEM FOR PROACTIVE HEALTH MANAGEMENT



(57) Abstract

A system and method for monitoring a group of patients who have a chronic disease or ongoing health condition. The method comprises the steps of recording sets of measurements of patient's sites (200); transmitting the sets of measurements (200) to a remote database (18). Control values (206) are calculated, and the level of completeness of the measurements (210) and the compliance levels (208) are determined for each patient. Electronic messages (220) may be sent to selected patients as obtained from patient charts (218) in a display group overview chart (216).

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

MULTIPLE PATIENT MONITORING SYSTEM FOR PROACTIVE HEALTH MANAGEMENT

RELATED APPLICATION INFORMATION

This application claims priority from copending U.S. application Ser. No. 08/732,158 filed October 16, 1996 which is hereby incorporated by reference.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to computer systems for managing healthcare, and in particular to a system and method for proactively monitoring a group of patients having a chronic disease or ongoing health condition.

BACKGROUND OF THE INVENTION

Managing a chronic disease or ongoing health condition requires the monitoring and controlling of a physical or mental parameter of the health condition. Examples of these control parameters include blood glucose in diabetes, respiratory flow in asthma, blood pressure in hypertension, cholesterol in cardiovascular disease, weight in eating disorders, T-cell or viral count in HIV, and frequency or timing of episodes in mental health disorders. Because of the continuous nature of these health conditions, their corresponding parameters must be monitored and controlled on a regular basis by the patients themselves outside of a medical clinic.

Typically, the patients monitor and control these parameters in clinician assisted self-care or outpatient treatment programs. While these treatment programs offer significant advantages for

patients and healthcare providers, they present the assisting clinician with two problems in effectively managing the medical priorities of his or her patients. The first problem is in determining each patient's current medical status. Since the patients themselves monitor their health conditions, the clinician is often limited to learning each patient's status strictly through patient initiated events, such as an emergency visit or the delivery of the patient's latest medical data. Even with the current availability of remote monitoring devices which store and transmit medical data from a patient's home to a clinic, the clinician must still wait for medical information whose arrival depends on the patient's initiative.

As a result, the majority of the clinician's time is spent with the patients who are the most motivated and eager for a response, while the greatest medical needs remain with the unmotivated patients who do not visit the clinician or transmit their medical data. These unmotivated patients often develop urgent medical needs that could have been prevented with proper medical management. Consequently, the cost of treating their health conditions is much higher than one might expect given the sophistication of current medical monitoring devices.

The second problem is in determining which patients are having the greatest difficulty in controlling their health condition so that the clinician may focus attention on these patients. Unfortunately, most existing healthcare information systems are only designed to display medical data on an individual patient basis. Few systems have been developed that enable clinicians to view medical data for an entire group of patients simultaneously. Consequently, it is extremely difficult for a clinician to prioritize his or her time and efforts in a manner that optimizes care and minimizes costs and complications for the entire group of patients.

Several data collection systems have been developed for remote monitoring of a group of patients. For example, U.S. Patent 5,357,427 issued to Langen et al. on October 18, 1994 describes a

system for simultaneous remote monitoring of a group of high risk patients using artificial intelligence. Each patient is provided with a remote monitoring device, such as a blood pressure cuff or blood glucose meter. The remote monitoring device is connected to a telemedical interface box which transmits monitored data over a telephone line to a data recording system. Data is also collected from each patient using an artificial intelligence program that asks the patient questions through a telephone. A computer is connected to the recording system to display messages indicating a current symptom of one of the patients.

Although Langen's system allows medical data to be collected from a group of patients, it lacks a display mechanism for simultaneously displaying summary data for the entire group of patients. Langen's system also lacks a mechanism for indicating which patients have been out of contact with the clinician and therefore have an unknown current medical status. Consequently, Langen's system is ineffective in aiding the clinician to prioritize his or her time and efforts in managing the medical priorities of the entire group of patients.

Another system designed to monitor a group of patients is disclosed in U.S. Patent 5,331,549 issued to Crawford on July 19, 1994. Crawford's system includes a plurality of monitors for monitoring the vital signs of a plurality of patients. Each monitor provides a continuous data stream to a central server. A supervisory screen is connected to the server to display the current status of each patient's vital signs. The system further provides a warning alarm signal when any patient's vital signs exceed a predetermined limit.

While Crawford's system allows simultaneous viewing of the vital sign status of each patient, it is only directed at monitoring a group of patients who are continually connected to their monitors. Crawford's overview screen lacks any mechanism for indicating which patients have been out of contact with a clinician, since continual contact is assumed. Further, the summary data presented on the overview screen is limited to an indication of a normal

state or alarm state of each patient's vital signs. Consequently, the system only allows a clinician to determine which patients are having the greatest difficulty in controlling their health condition when an actual emergency situation exists. Thus, Crawford's system is effective as a medical alarm system, but of little use to a clinician in managing the medical priorities of a group of patients who are not continually monitored in a healthcare facility.

OBJECTS AND ADVANTAGES OF THE INVENTION

In view of the above, it is an object of the present invention to provide a multiple patient monitoring system which allows a clinician to view and manage the medical priorities of an entire group of patients. It is another object of the invention to provide a multiple patient monitoring system which allows a clinician to communicate proactively with unmotivated patients who have lost contact with the clinician. A further object of the invention is to provide a multiple patient monitoring system which allows a clinician to optimize efforts and minimize costs in managing the medical needs of the entire group of patients.

These and other objects and advantages will become more apparent after consideration of the ensuing description and the accompanying drawings.

SUMMARY OF THE INVENTION

The invention presents a system and method for monitoring a group of patients who have a chronic disease or ongoing health condition. The method includes the step of collecting from each patient at least one corresponding set of measurements of a control parameter of the health condition. Each set of measurements has a corresponding collection date. For each patient, a control value is then calculated from the patient's corresponding set of measurements. The control value indicates the patient's control over the health condition and is preferably a mean value of the patient's measurements.

The method also includes the step of determining for each patient a time period which has elapsed since the collection date of the set of measurements most recently collected from the patient. The method further includes the steps of generating and displaying an overview chart having a plurality of data points. Each of the data points represents a respective one of the patients and indicates the control value and the time period determined for the patient. In a preferred embodiment, the method includes the additional steps of selecting from the chart at least one of the patients represented thereon and automatically transmitting supervisory instructions to the selected patient. In one embodiment, the supervisory instructions are transmitted in an electronic mail message. In another embodiment, the supervisory instructions are transmitted in an automated telephone message.

A preferred system for implementing the method of the invention includes a plurality of recording devices, such as monitoring devices or electronic logbooks, for recording the sets of measurements. The system also includes a server which is networked to the recording devices. The server includes a patient database for receiving and storing each set of measurements with its corresponding collection date. The server also includes a software application for generating the overview chart from the collected measurements. A display is connected to the server for displaying the overview chart to a clinician.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram of a multiple patient monitoring system according to a preferred embodiment of the invention.

FIG. 2 is a schematic block diagram illustrating the data collected from each patient according to the preferred embodiment of the invention.

FIG. 3 is a sample group overview chart according to the preferred embodiment of the invention.

FIGS. 4-5 are sample electronic mail messages containing supervisory instructions for a patient.

FIG. 6 is a flow chart illustrating steps included in a preferred method of the invention.

FIG. 7 is a schematic block diagram of another multiple patient monitoring system according to a second embodiment of the invention.

FIG. 8 is a sample telephone message containing supervisory instructions for a patient.

DETAILED DESCRIPTION

FIGS. 1 - 6 illustrate a preferred embodiment of the invention. FIG. 1 shows the main components of a system for monitoring a group of patients having a chronic disease or ongoing health condition. A healthcare clinic **10** has a clinic server **12** that includes a mail merge application **14**, a mail server application **16**, a patient database **18**, and an overview application **20**. It will be apparent to one skilled in the art that clinic server **12** may comprise a single stand-alone computer or multiple computers distributed throughout a network.

Mail merge application **14** is designed to generate electronic mail messages containing supervisory instructions for patients, as will be explained in the operation section below. Mail server application **16** is a standard electronic mail server for transmitting the messages to the patients. Database **18** stores data relating to each patient managed by clinic **10**. Overview application **20** is a software application for performing various calculations using the data stored in database **18** and for generating an overview chart **26** from the data, as will be explained in detail below. Server **12** is coupled to a modem **M1** which connects server **12** to a communication network **34**. Network **34** is preferably a public telephone network, the Internet, or a similar data transmission network.

A clinician workstation **22** is networked to clinic server **12**. Workstation **22** is preferably a personal computer or network

terminal. Workstation **22** has a display **24** for displaying overview chart **26** to a clinician **30**. Workstation **22** further includes a user selection device **28**, such as a mouse or keyboard. Selection device **28** is used by clinician **30** to select the patients represented on chart **26** who are to receive supervisory instructions.

A patient unit **38** is located at a first patient site **36**, typically the patient's home. Patient unit **38** displays electronic mail messages which are received from mail server **16**. In the preferred embodiment, patient unit **38** is a personal computer having a display monitor. However, in alternative embodiments, patient unit **38** may be any information processing and display unit, such as a network terminal, a television set with a set-top converter box, a personal digital assistant, or a video game system. Patient unit **38** includes a message display **40** for displaying the electronic mail messages. Patient unit **38** is connected to communication network **34** via a modem **M2**.

A recording device, such as a medical monitoring device **42**, is also connected to communication network **34** via modem **M2**. Monitoring device **42** is for collecting from a first patient **44** a set of measurements of a control parameter of the patient's health condition. The specific type of monitoring device provided to each patient is dependent upon the patient's disease and its corresponding control parameter. For example, diabetes patients are provided with blood glucose meters for measuring blood glucose concentrations, asthma patients are provided with respiratory flow meters for measuring peak flow rates, obesity patients are provided with weight scales, etc. Monitoring device **42** is capable of recording each measurement in the set with a corresponding measurement date and measurement time. Device **42** is also capable of transmitting the measurements to database **18** through communication network **34**. Such monitoring devices for recording and transmitting measurements are well known in the art.

A second patient site **46** includes the same equipment as first patient site **36**, with the exception of the recording device used

by a second patient **49**. The recording device at second patient site **46** is an electronic logbook **48** for recording a set of measurements entered by the second patient. Logbook **48** is capable of recording each measurement with a corresponding measurement date and measurement time. Logbook **48** is designed to transmit the recorded set of measurements to database **18** through communication network **34**. Such electronic logbooks for recording and transmitting data are well known in the art. The use of logbook **48** to record and transmit measurements enables those patients with mental health conditions or other condition whose control parameters may not be physically measured to participate in the monitoring system.

For simplicity of illustration, only two patient sites and two corresponding patients are shown in FIG. 1. It is obvious that the system of the invention may be effectively used to monitor any number of patients. In a typical implementation, hundreds of patient sites are connected to clinic server **12** via communication network **34**.

FIG. 2 is a schematic block diagram illustrating the data which is collected from each patient and stored in database **18**. The data includes at least one set of measurements **52** of a control parameter of the health condition. Each measurement includes a control parameter value **54**, such as a blood glucose concentration for a diabetes patient, a peak flow rate for an asthma patient, or a blood pressure reading for a hypertension patient. Each measurement also includes a measurement date **56** and a measurement time **58**.

The actual number of measurements in each set varies in dependence upon the nature of the health condition being monitored and the duration of time over which the measurements are recorded. For example, diabetes patients typically measure their blood glucose several times per day, so that these patients preferably record twenty to forty measurements in a typical week of monitoring. However, hypertension patients may only be required to measure

their blood pressure once a week, so that these patients would record only one measurement in a typical week of monitoring.

Each set of measurements is stored in database **18** with a corresponding collection date **64**. In the preferred embodiment, collection date **64** is the date the set of measurements is received by database **18**. In an alternative embodiment, collection date **64** is the date the set of measurements is transmitted to the database. In another embodiment, collection date **64** is the measurement date **56** of the most recent measurement in the set. In addition to storing the measurements, database **18** stores information **62** relating to each patient participating in the monitoring system. In the preferred embodiment, the information includes each patient's name, telephone number, and electronic mail address.

Referring again to FIG. 1, software application **20** is designed to perform various functions using the data stored in database **18**. First, application **20** is designed to calculate a control value for each patient from the patient's corresponding set of measurements. The control value is calculated to give a clear indication of the patient's control over the health condition.

In the preferred embodiment, the control value calculated for each patient is simply the mean value of the measurements recorded by the patient over a preselected period of time. In an alternative embodiment, the control value is the mean value of the set of measurements most recently collected from the patient. The period of time used to calculate the control value varies in dependence upon the nature of the patient's health condition. For example, a useful period of time for calculating a mean blood glucose value for diabetes patients is typically one week, while a useful period of time for calculating a mean daily number of panic attacks for phobic patients is typically two weeks. The period of time used to calculate the control value is preferably selected by the clinician.

Second, software application **20** is designed to determine for each patient a time period which has elapsed since the collection date of the set of measurements most recently collected from the patient. For example, if a patient has only transmitted one set of measurements to the database, application **20** determines the time period that has elapsed since the collection date of the one set. If a patient has transmitted multiple sets of measurements to the database, application **20** determines the time period that has elapsed since the most recent collection date.

Third, application **20** is designed to determine the compliance of each patient with a prescribed measurement regimen. The prescribed measurement regimen preferably includes prescribed measurement dates and prescribed measurement times. To determine the compliance of each patient, application **20** compares each patient's actual measurement dates and times with the prescribed measurement dates and times. For example, it is usually important that a diabetes patient measure his or her blood glucose every morning before breakfast. Thus, one prescribed measurement time for a diabetes patient is 7 am, or similar pre-breakfast time. Application **20** compares the patient's actual measurement times with the prescribed pre-breakfast time to ensure that the patient is complying with the measurement regimen. Of course, any desired measurement time may be prescribed by the clinician.

The prescribed measurement regimen also preferably specifies the number of measurements to be taken by the patient in a predetermined period of time. Application **20** is further capable of determining a completeness of each set of measurements relative to the prescribed measurement regimen. For example, a typical diabetes regimen requires three blood glucose measurements per day. In this example, application **20** compares the actual number of measurements recorded by the patient on each measurement date to the three prescribed measurements to determine the completeness of the set.

Software application **20** is also designed to generate overview chart **26**. FIG. 3. illustrates a sample overview chart generated

for a group of ten diabetes patients. Chart **26** has ten data points, with each data point representing a respective one of the patients and indicating the control value calculated for the patient and the time period elapsed since the patient's most recent collection date. Thus, by viewing chart **26**, the clinician immediately sees which patients have been out of contact with the clinic and therefore have an unknown status and which patients are having the most difficulty controlling their illness and require special attention.

In the preferred embodiment, each data point is displayed on chart **26** as a respective icon **66**. Each icon indicates the compliance of the patient with the prescribed measurement regimen. A chart key **68** is provided to explain the significance of each icon's appearance. Non-compliant patients are represented by flashing icons, while compliant patients are represented by non-flashing icons. In FIG. 3, the flashing icons having dotted borders, while the non-flashing icons have solid borders. Alternatively, non-compliant patients may be represented by icons having a first color, while compliant patients are represented by icons having a second color. Each icon also indicates the completeness of the set of measurements most recently collected from the patient. Patients having complete sets are represented by filled icons, while patients having sparse sets are represented by blank icons. Of course, in alternative embodiments, the visual appearance of each icon may be varied in different ways to indicate the completeness of each patient's measurements.

Chart **26** further includes a list box **70**, a PRINT LIST button **74**, and a SEND MESSAGE button **76**. List box **70** lists the names of the patients who have been selected from chart **26** by the clinician. The icons representing the selected patients are highlighted, as shown by dotted circles **72**. PRINT LIST button **74** is pressed to send the list of names to a printer (not shown) to obtain a print out of the list. SEND MESSAGE button **76** is pressed to transmit the list of names to mail merge application **14**. Specific techniques for writing and implementing a software application to

perform the functions described will be apparent to one skilled in the art.

Mail merge application **14** is designed to generate customized electronic mail messages containing supervisory instructions for the selected patients. FIGS. 4 - 5 show sample electronic mail messages **78** and **80**. Mail merge application **14** is capable of customizing each message to include the patient's name, the patient's electronic mail address, and the collection date of the patient's most recent set of measurements. The programming of a mail merge application to generate customized messages in this manner is well known in the art.

The operation of the preferred embodiment is shown in FIGS. 1 - 6. FIG. 6 is a flow chart illustrating a preferred method of using the system to monitor a group of patients having a health condition. Each patient is provided with a recording device, such as monitoring device **42** or electronic logbook **48**. In step **200**, each patient records in his or her recording device at least one set of measurements **52** of a control parameter of the health condition. In step **202**, the sets of measurements are transmitted from each recording device to database **18** through communication network **34**. In step **204**, each set of measurements is stored in database **18** with its corresponding collection date **64**.

In step **206**, software application **20** calculates a control value for each patient from the collected measurements. In step **208**, application **20** determines each patient's compliance with the prescribed measurement regimen by comparing the patient's actual measurement times to the measurement times prescribed by the clinician. In step **210**, application **20** determines if the set of measurements most recently collected from each patient is complete relative to the prescribed measurement regimen. In step **212**, application **20** determines for each patient the time period which has elapsed since the collection date of the patient's most recent set of measurements.

In step **214**, application **20** generates overview chart **26**. In step **216**, chart **26** is displayed to the clinician on workstation **22**. As shown in FIG. 3, each data point on chart **26** is displayed as an icon. Each icon represents a respective one of the patients and indicates the control value and the elapsed time period determined for the patient. Each icon also indicates the patient's compliance with the prescribed measurement regimen and the completeness of the set of measurements most recently collected from the patient. Thus, chart **26** allows the clinician to determine which patients have been out of contact with the clinic, which patients are having difficulty controlling their disease, and which patients are having difficulty complying with the prescribed measurement regimen.

In step **218**, the clinician uses selection device **28** to select from chart **26** the patients who are to receive supervisory instructions. Typically, selection device **28** is a mouse or similar pointing device, and the clinician selects the patients by clicking the appropriate icons. As the clinician selects the patients, their names are displayed in list box **70**. Next, the clinician presses SEND MESSAGE button **76** to transmit the list of selected patients to mail merge application **14**.

Mail merge application **14** generates a customized electronic mail message for each patient selected by the clinician. Mail merge application **14** customizes each message to include the patient's name, electronic mail address, and the collection date of the patient's most recent set of measurements. In step **220**, mail server application **16** transmits the messages to the patients through communication network **34**. When the patients receive the supervisory instructions, they continue the monitoring loop with the clinician by returning to step **200** and repeating the method described.

One advantage of the monitoring system of the present invention is that it allows the clinician to view and manage the medical priorities of an entire group of patients simultaneously. It also allows the clinician to communicate proactively with unmotivated

patients who have lost contact with the clinician before they develop urgent medical needs. Consequently, the system allows the clinician to optimize efforts and minimize costs in managing the care of the entire group of patients.

A second embodiment of the invention is shown in FIGS. 7 - 8. The second embodiment differs from the preferred embodiment in the method of transmitting supervisory instructions to the selected patients. According to the second embodiment, clinic server **12** includes an automated telephone call processing application **82** in place of mail merge application **14** and mail server application **16**. Call processing application **82** is designed to generate automated telephone messages containing supervisory instructions for the selected patients.

FIG. 8 illustrates a sample automated telephone message **88**. Application **82** is capable of customizing each message to include the patient's name and the collection date of the patient's most recent set of measurements. The programming of an automated call processing application to generate customized messages in this manner is well known in the art. Referring again to FIG. 7, clinic server **12** is connected to a telephone network **84** through a digital/tone signal converter **D1**. Each patient is provided with a dual tone multi-frequency (DTMF) telephone **86**. Each telephone is connected to telephone network **84** to receive automated telephone messages from clinic server **12**.

The operation of the second embodiment differs from the operation of the preferred embodiment in that supervisory instructions are transmitted to the selected patients in automated telephone messages rather than in electronic mail messages. Otherwise, the operation and advantages of the second embodiment are analogous to those of the preferred embodiment described above.

SUMMARY, RAMIFICATIONS, AND SCOPE

Although the above description contains many specificities, these should not be construed as limitations on the scope of the

invention but merely as illustrations of some of the presently preferred embodiments. Many other embodiments of the invention are possible. For example, the patient database and software applications may be installed on the clinician's workstation, and the clinic server may be eliminated. The clinic server is presently preferred for performing resource intensive operations, such as storing and manipulating large amounts of patient data, but the clinic server is not necessary to enable the system and method of the invention. In embodiments that include the clinic server, the server need not be physically located at the clinic. The server may be located off-site and networked to the clinician workstation.

Moreover, the preferred embodiment describes the use of monitoring devices and electronic logbooks for collecting data from each patient. However, many other methods of collecting data from the patients are possible. For example, the patients may be provided with paper based logbooks and automated readers for digitizing and transmitting the logbook information to the database. Alternatively, patients may mail or fax the logbook information to the clinic for entry into the database. In another embodiment, the patients use DTMF telephones to connect to the database and enter their data through the telephone keypads.

Further, the electronic mail messages and automated telephone messages illustrated are exemplary of the preferred embodiment. Many other messages may be generated and transmitted to patients in alternative embodiments. Additionally, the preferred embodiment describes a system and method for monitoring patients having diabetes. However, the invention is not limited to monitoring diabetes patients. The system and method are equally effective for managing patients who have asthma, hypertension, cardiovascular disease, eating disorders, HIV, mental health disorders, or any other health condition having a measurable control parameter.

Therefore, the scope of the invention should be determined not by the examples given but by the appended claims and their legal equivalents.

CLAIMS

What is claimed is:

1. A method for monitoring a group of patients having a health condition, the method comprising the computer implemented steps of:

a) collecting from each of the patients at least one corresponding set of measurements of a control parameter of the health condition, wherein each of the sets has a corresponding collection date;

b) for each of the patients, calculating from the corresponding set of measurements a control value indicating the patient's control over the health condition;

c) for each of the patients, determining a time period which has elapsed since the collection date of the set of measurements most recently collected from the patient; and

d) generating and displaying a chart having a plurality of data points, wherein each of the data points represents a respective one of the patients and indicates the control value and the time period determined for the patient.

2. The method of claim 1, further comprising the steps of selecting from the chart at least one of the patients represented thereon and automatically transmitting supervisory instructions to the selected patient.

3. The method of claim 2, wherein the instructions are transmitted in an electronic mail message.

4. The method of claim 2, wherein the instructions are transmitted in a telephone message.

5. The method of claim 1, further comprising the steps of determining a compliance of each of the patients with a prescribed measurement regimen and indicating the compliance on the chart.

6. The method of claim 5, wherein each of the data points is displayed on the chart as a respective icon whose appearance indicates the compliance of the represented patient.

7. The method of claim 1, further comprising the steps of determining a completeness of each of the sets of measurements relative to a prescribed measurement regimen and indicating the completeness on the chart.

8. The method of claim 7, wherein each of the data points is displayed on the chart as a respective icon whose appearance indicates the completeness of the set of measurements collected from the represented patient.

9. The method of claim 1, wherein the control value calculated for each of the patients comprises a mean value of the set of measurements collected from the patient.

10. A system for monitoring a group of patients having a health condition, the system comprising:

a) a collection means for collecting from each of the patients at least one corresponding set of measurements of a control parameter of the health condition, wherein each of the sets has a corresponding collection date;

b) a processor means connected to the collection means for determining for each of the patients:

i) a control value indicating the patient's control over the health condition, the control value being calculated from the patient's corresponding set of measurements; and

ii) a time period which has elapsed since the collection date of the set of measurements most recently collected from the patient;

wherein the processor means further includes means for generating a chart having a plurality of data points, and wherein each of the data points represents a respective one

of the patients and indicates the control value and the time period determined for the patient; and

c) a display means connected to the processor means for displaying the chart.

11. The system of claim 10, further comprising:

a) selection means connected to the processor means for selecting from the chart at least one of the patients represented thereon; and

b) automated response means connected to the processor means for transmitting supervisory instructions to the selected patient.

12. The system of claim 11, wherein the automated response means comprises electronic mail means for transmitting the instructions in an electronic mail message.

13. The system of claim 11, wherein the automated response means comprises call processing means for transmitting the instructions in a telephone message.

14. The system of claim 10, wherein the processor means further includes means for determining a compliance of each of the patients with a prescribed measurement regimen and means for visually indicating the compliance on the chart.

15. The system of claim 14, wherein each of the data points is displayed on the chart as a respective icon whose appearance indicates the compliance of the represented patient.

16. The system of claim 10, wherein the processor means further includes means for determining a completeness of each of the sets of measurements relative to a prescribed measurement regimen and means for visually indicating the completeness on the chart.

17. The system of claim 16, wherein each of the data points is displayed on the chart as a respective icon whose appearance indicates the completeness of the set of measurements collected from the represented patient.

18. The system of claim 10, wherein the control value calculated for each of the patients comprises a mean value of the set of measurements collected from the patient.

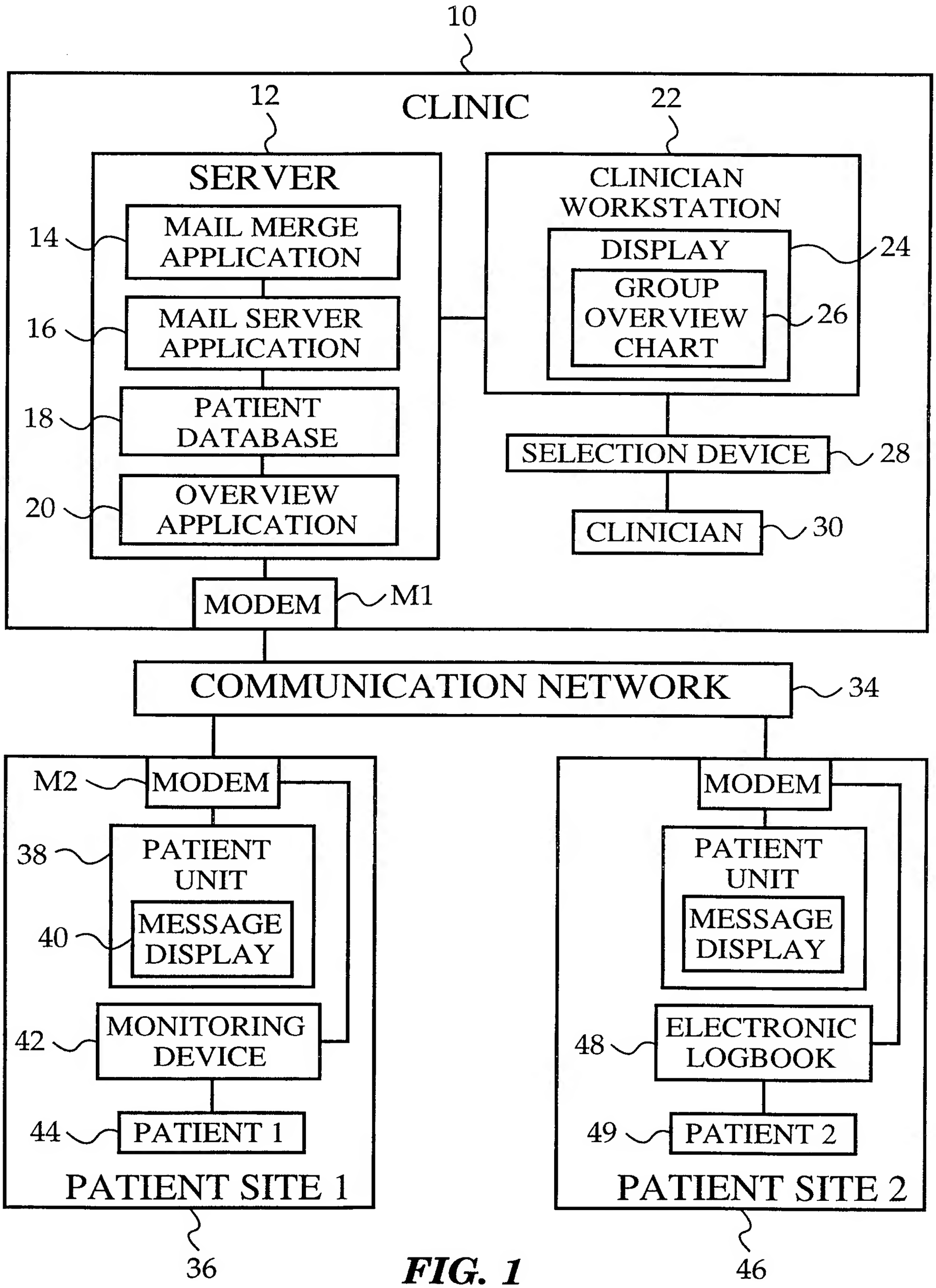

10
CLINIC
12
SERVER
14
MAIL MERGE APPLICATION
16
MAIL SERVER APPLICATION
18
PATIENT DATABASE
20
OVERVIEW APPLICATION
MODEM
M1
22
CLINICIAN WORKSTATION
DISPLAY
24
GROUP OVERVIEW CHART
26
SELECTION DEVICE
28
CLINICIAN
30
COMMUNICATION NETWORK
34
M2
MODEM
38
PATIENT UNIT
40
MESSAGE DISPLAY
42
MONITORING DEVICE
44
PATIENT 1
PATIENT SITE 1
36
MODEM
PATIENT UNIT
MESSAGE DISPLAY
48
ELECTRONIC LOGBOOK
49
PATIENT 2
PATIENT SITE 2
46

FIG. 1

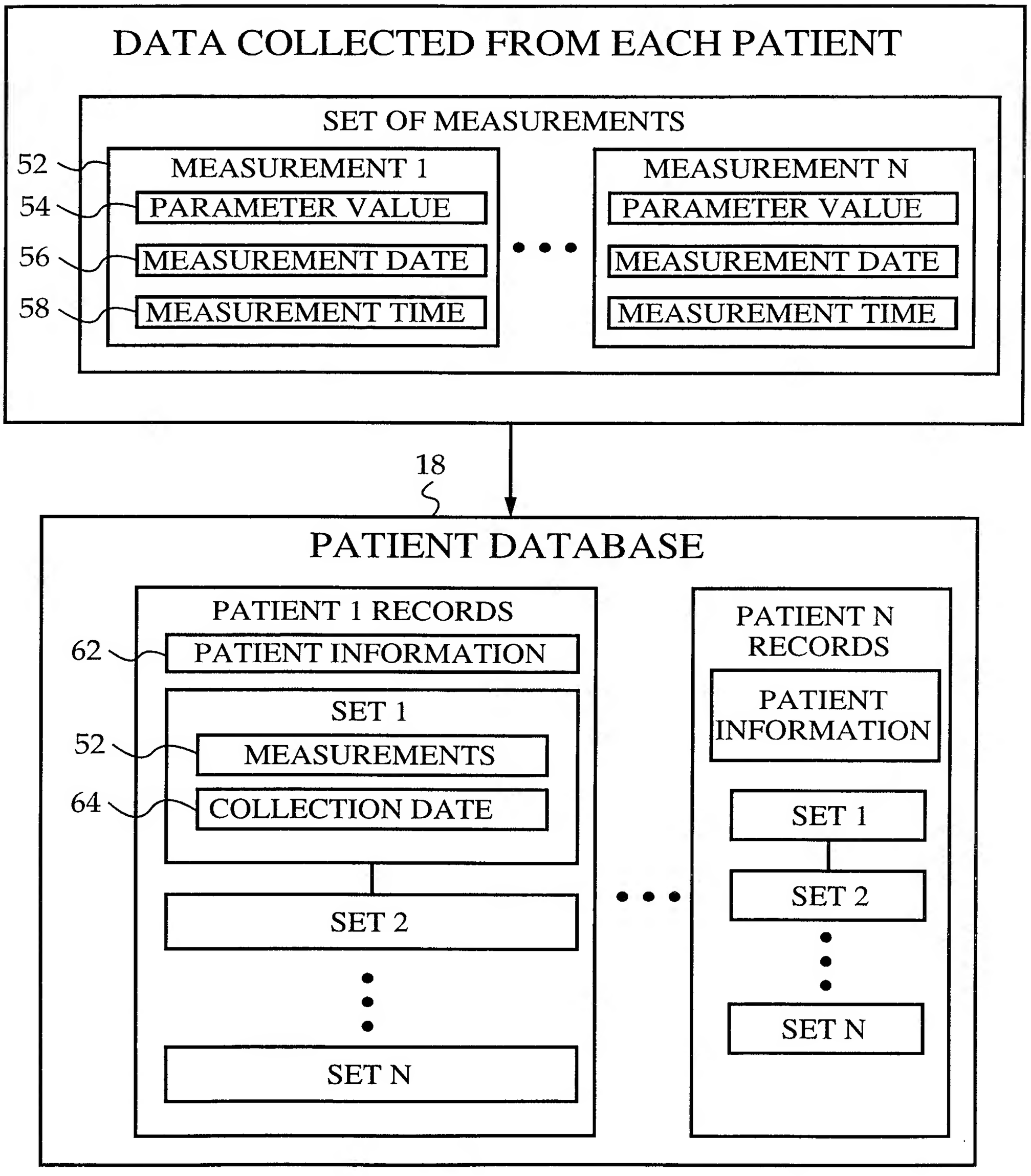

DATA COLLECTED FROM EACH PATIENT
SET OF MEASUREMENTS
52
MEASUREMENT 1
54
PARAMETER VALUE
56
MEASUREMENT DATE
58
MEASUREMENT TIME
MEASUREMENT N
PARAMETER VALUE
MEASUREMENT DATE
MEASUREMENT TIME
18
PATIENT DATABASE
PATIENT 1 RECORDS
62
PATIENT INFORMATION
SET 1
52
MEASUREMENTS
64
COLLECTION DATE
SET 2
SET N
PATIENT N RECORDS
PATIENT INFORMATION
SET 1
SET 2
SET N

FIG. 2

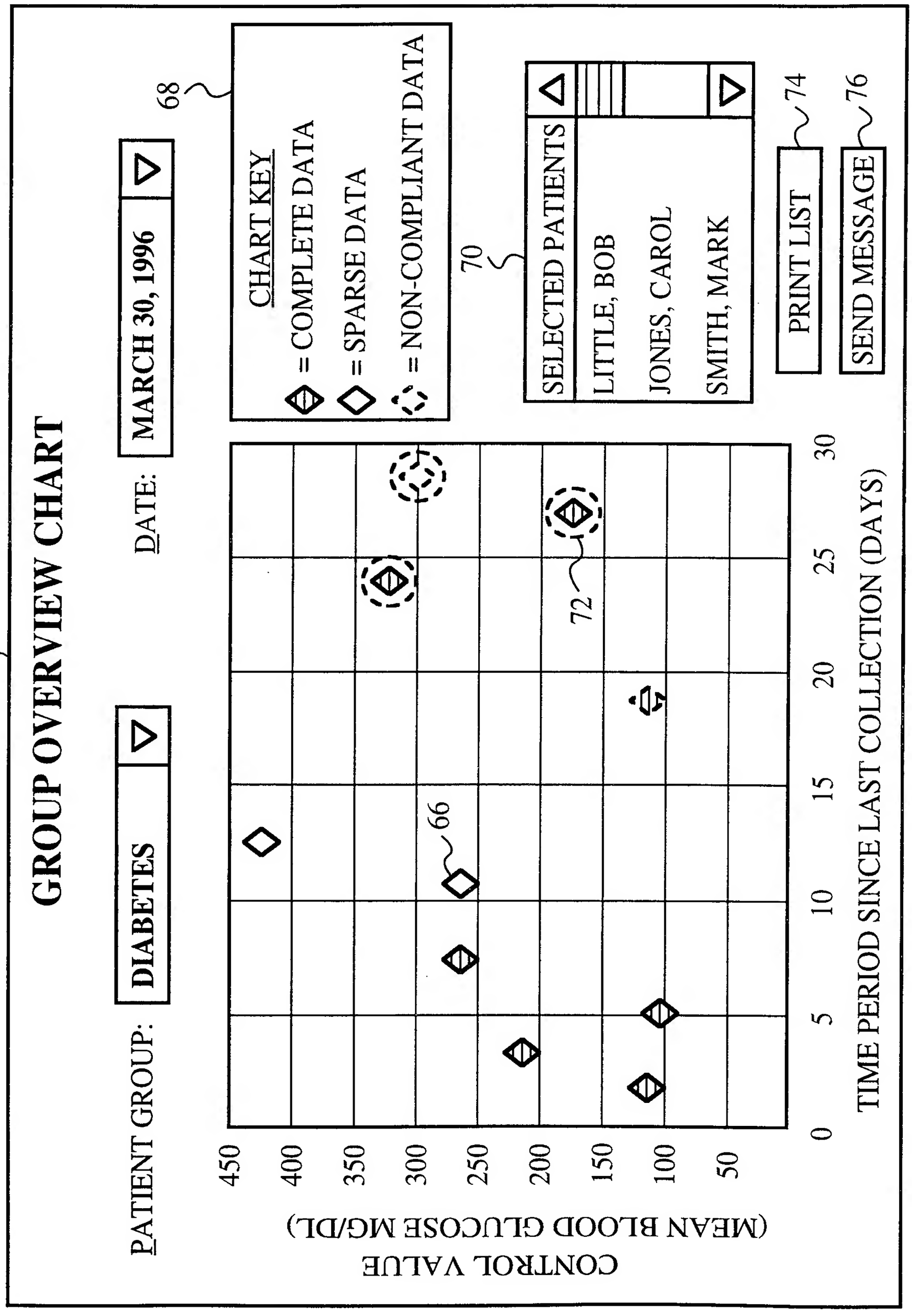

26
GROUP OVERVIEW CHART
PATIENT GROUP: DIABETES
DATE: MARCH 30, 1996
68
CHART KEY
= COMPLETE DATA
= SPARSE DATA
= NON-COMPLIANT DATA
70
SELECTED PATIENTS
LITTLE, BOB
JONES, CAROL
SMITH, MARK
PRINT LIST
74
SEND MESSAGE
76
66
72
CONTROL VALUE
(MEAN BLOOD GLUCOSE MG/DL)
450
400
350
300
250
200
150
100
50
0
5
10
15
20
25
30
TIME PERIOD SINCE LAST COLLECTION (DAYS)

FIG. 3

78

TO:	<< INSERT PATIENT MAIL ADDRESS >>
SUBJECT:	REQUEST FOR BLOOD GLUCOSE MEASUREMENTS

Hello << INSERT PATIENT NAME >>,

I have not received your blood glucose measurements since << INSERT COLLECTION DATE >> and I am concerned that your blood glucose level stay in control. Please transmit your latest measurements to the clinic today.

Sincerely,

Dr. Peters

FIG. 4

80

TO:	<< INSERT PATIENT MAIL ADDRESS >>
SUBJECT:	MEASURE YOUR BLOOD GLUCOSE REGULARLY

Hello << INSERT PATIENT NAME >>,

Your last set of blood glucose measurements did not include an adequate number of measurements to assess your progress in controlling diabetes. Please remember to test your blood glucose regularly so that we may work together to keep your diabetes in control.

Sincerely,

Dr. Peters

FIG. 5

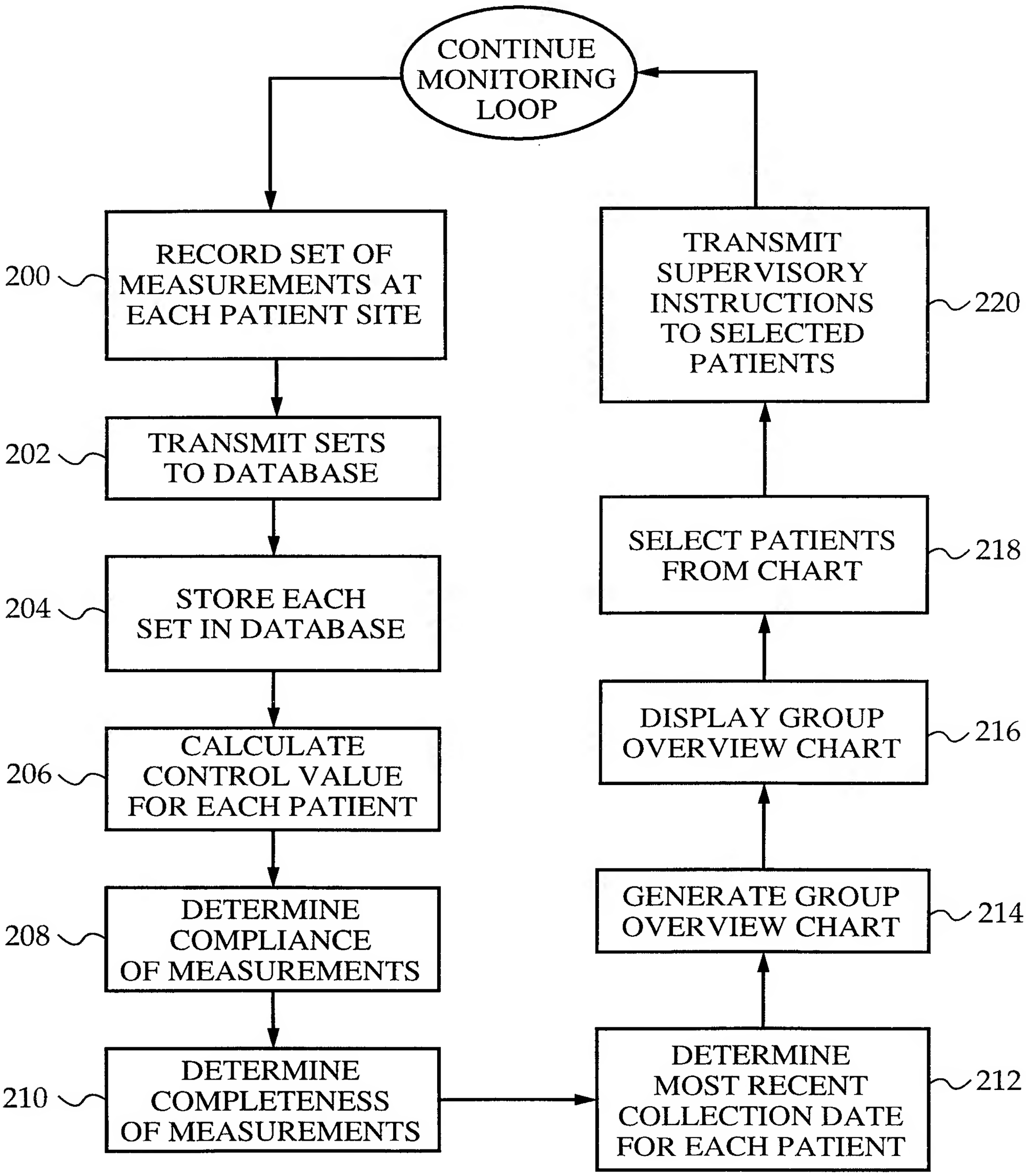

CONTINUE MONITORING LOOP
RECORD SET OF MEASUREMENTS AT EACH PATIENT SITE
200
TRANSMIT SETS TO DATABASE
202
STORE EACH SET IN DATABASE
204
CALCULATE CONTROL VALUE FOR EACH PATIENT
206
DETERMINE COMPLIANCE OF MEASUREMENTS
208
DETERMINE COMPLETENESS OF MEASUREMENTS
210
DETERMINE MOST RECENT COLLECTION DATE FOR EACH PATIENT
212
GENERATE GROUP OVERVIEW CHART
214
DISPLAY GROUP OVERVIEW CHART
216
SELECT PATIENTS FROM CHART
218
TRANSMIT SUPERVISORY INSTRUCTIONS TO SELECTED PATIENTS
220

FIG. 6

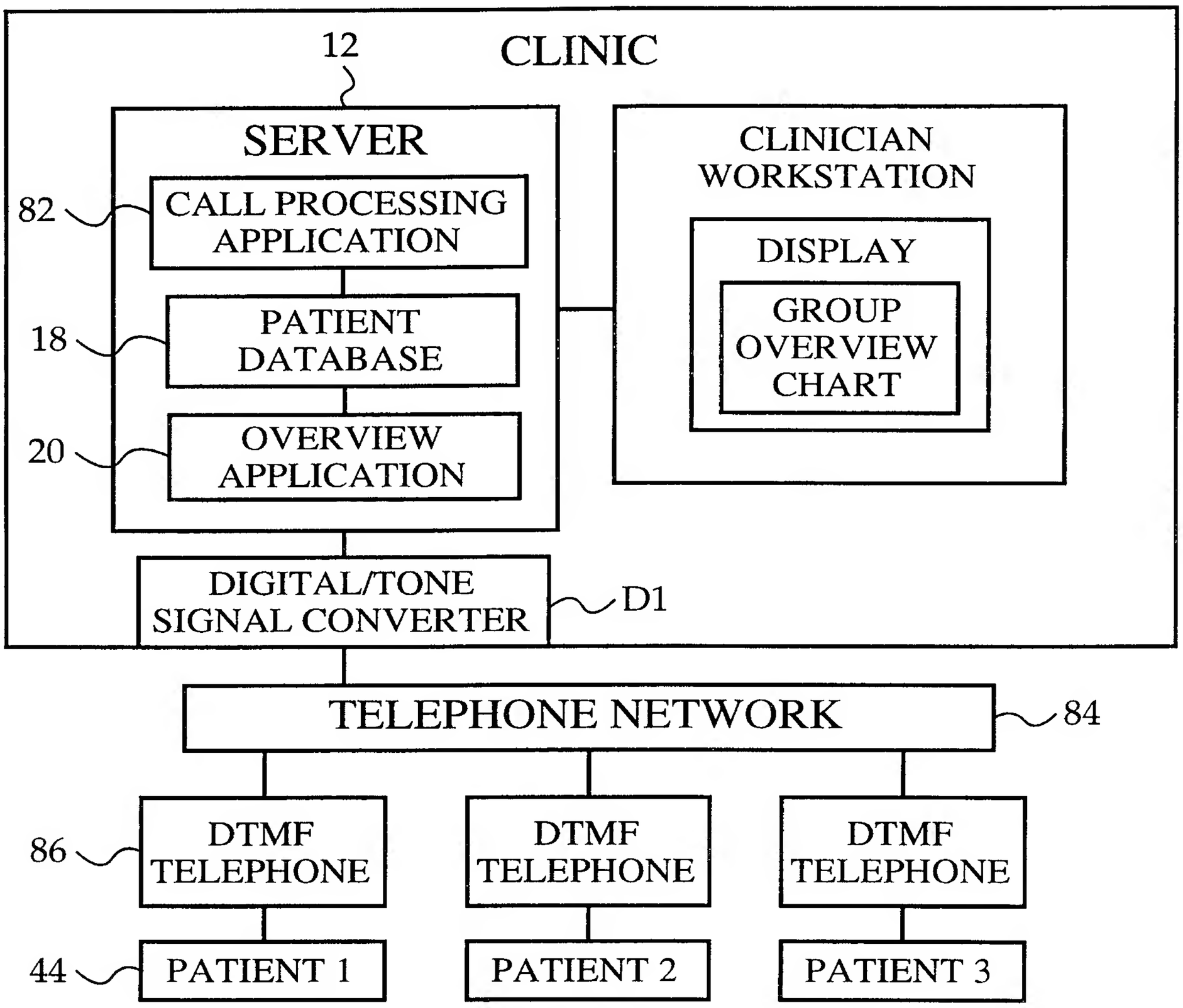


FIG. 7

88

This is Dr. Peters calling from the Medical Clinic for << INSERT PATIENT NAME >>. If this is <<INSERT PATIENT NAME>>, press 1.

I have not received your blood glucose measurements since << INSERT COLLECTION DATE >> and I am concerned that your blood glucose level stay in control. Please transmit your latest measurements to the clinic today.

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US97/18175

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G06F 159:00
US CL : 705/2

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/2, 3

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,549,117 A (TACKLIND et al.) 27 August 1996, column 8, line 6 to column 9, line 13; column 10, line 64 to column 11, line 25.	1-18
A	US 5,331,549 A (CRAWFORD et al.) 19 July 1994, column 2, line 30 to column 3, line 7.	1-18
A	US 4,858,354 A (GETTLER) 22 August 1989, abstract and column 1, line 25 to column 2, line 40.	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
05 FEBRUARY 1998	10 MAR 1998
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Frantzy Poinvil Telephone No. (703) 305-9779

Form PCT/ISA/210 (second sheet)(July 1992)★